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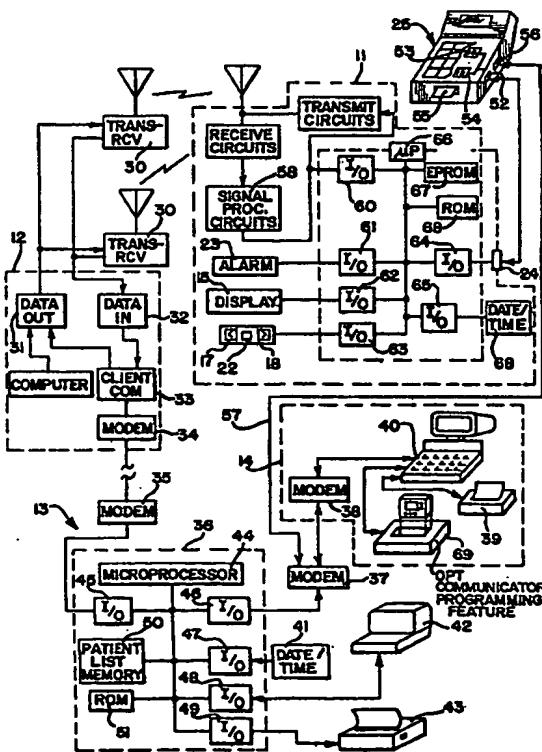
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**(54) Title: MEDICATION DISPENSING AND TIMING SYSTEM**

**(57) Abstract**

A medication dispensing and timing system includes a central monitoring facility (13) and a plurality of patient communicators (11). The central monitoring computer (36) may generate and send an address-specific medication prompting message in accordance with a prescribed medication dispensing schedule over a two-way paging system to a communicator (11) carried by a patient. Alternatively, the computer (36) may generate and send a periodic time reference message to all of the patient communicators (11). Each communicator (11) may include receiver circuitry which responds to the prompt message to generate a display (15) and audible alarm (23) to alert the patient, sufficient memory to store the individual medication schedule of the particular patient, processing circuitry (58), and a clock circuit providing time and date information utilized in conjunction with the stored schedule to provide visual and aural prompts to the patient as medication is to be taken.



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## MEDICATION DISPENSING AND TIMING SYSTEM

### Background of the Invention

The present invention relates generally to medication dispensing systems, and more particularly to a medication dispensing system wherein the patient is prompted to take medication immediately or in accordance with a prescribed medication schedule by a communicator device carried on his person, and acknowledges receipt of the prompt by sending a reply message to a computer at a central monitoring office. An emergency notification procedure is initiated by the computer in the event the reply message is not received within a predetermined period of time following the prompt.

In the dispensing of medication a primary problem has been recognized in prompting a patient to take a prescribed dose of medication at prescribed times. Patients are often preoccupied with other matters and may forget to take their medication at the prescribed time. In the case of some geriatric patients, a loss of mental acuity may cause a lapse of memory or an extended period of forgetfulness, resulting in no medication or the wrong medication being taken.

Various devices have been developed for prompting a patient to take medication, including medication dispensers incorporating a timer and programmable alarm and/or dispensing means operable from the timer.

Past devices for dispensing medications have included automated dispensers. An example of one such device is disclosed in U.S. Patent No. 4,763,810, issued August 16, 1988, which describes a motor-driven, tamper-proof automated medication dispenser. This automated dispenser has multiple compartments, each holding a single dose of medication and linked to a programmable clock circuit. A motorized delivery system is controlled by the clock circuit to remove a dose of medication from specific compartments. This automated dispensing device further includes an audio and visual alarm which notifies the patient that a dose of medication is ready

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for taking. However, the device does not include means for monitoring whether the patient has actually removed the medication dose from the dispenser and further does not include means for monitoring whether the patient has actually 5 followed his/her medication schedule and taken the appropriate medication.

U.S. Patent No. 4,223,801, issued September 23, 1980, describes an automated medication dispenser which is equipped with an alarm for alerting a patient when medication is to be 10 taken. A remote control automated alarm generates an alarm signal upon reception of a paging signal by the dispenser indicating that it is time to take medication, the signal being terminated when the medication is removed from the dispenser. Although this dispenser can be activated remotely 15 by a third party, it only alerts the patient that it is time to take medication and has no provision for confirming that the patient has or has not taken the medication.

These prior art devices do not permit monitoring of a dispensing schedule at a remote location, nor do they remind a 20 patient away from the dispenser that it is time to take his/her medication. A need therefore exists for an automated medication dispensing system which alerts a patient in the course of his daily activities to take specific medication and which confirms that the patient has taken the medication, 25 whereby the medication schedule of the patient can be monitored at a control monitoring facility.

The present invention meets this need by providing a medication dispensing and timing system in which a patient 30 communicator including a radio frequency receiver receives coded signals from the monitoring office and is activated to sound an alarm and provide a display according to a preassigned medication dispensing schedule. The patient confirms the prompt by actuating a transmitter, which generates a signal received at the monitoring office.

35 The present invention also, alternatively or in combination, provides a medication dispensing and timing system in which a patient communicator including a radio

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frequency receiver receives coded time reference signals from a central monitoring office and compares these to the patient dispensing schedule stored in an internal memory to sound an alarm and provide a display when required by the medication dispensing schedule. The patient confirms the prompt by actuating a transmitter within the communicator, which generates a signal which is received at the monitoring office.

5 Each patient communicator includes a date and time clock circuit, which accurately reflects current date and time. In  
10 addition, each communicator includes sufficient memory to store the medication schedule of the patient. This is periodically accessed according to the date and time signaled by the clock circuit to cause a prompt signal to be generated as each medication event of the schedule is to occur. This  
15 prompt is displayed to the patient and an audible alarm is sounded.

20 To reduce the number of prompts required, the system, instead of sending a separate page to each communicator to prompt each medication event, sends universal periodic time reference pages to all communicators. Each communicator includes sufficient memory to store the medication schedule of the patient, and upon receipt of each time reference page determines from this memory whether medication is to be taken, and if so, the identification of the medication. This is  
25 displayed to the patient and an audible alarm is sounded.

30 The medication dispensing schedule is transferred into the communicator memory through a data port, which may be connected to a computer terminal at the pharmacy where the prescription is filled, or may be connected to the monitoring computer at the central monitoring facility, which, in turn, receives the medication schedule from the pharmacist.

35 In any event, if a reply message is not received at the central monitoring computer within a predetermined period of time following a schedule medication event, a follow-up individually addressed prompt message is sent to the particular patient communicator. In the event that this message is not responded to, a supplemental procedure is

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initiated where help is obtained by telephone.

Thus, the present invention includes a two-way communicator which is carried by the patient and which receives and decodes prompt signals, which may include 5 periodic time reference signals, transmitted from a monitoring center to advise the patient that it is time to take medication in accordance with the preassigned schedule. The communicator may include utilization of an internal time and day clock circuit and stored medication schedule to advise the 10 patient that it is time to take medication in accordance with the preassigned schedule and will transmit a reply signal to the dispensing control center upon receipt of the prompt signal. In the absence of a reply signal, the central monitoring facility sends a further prompt signal and 15 initiates a supplemental procedure to secure help.

Also, the dispensing apparatus may be provided with a telephone modem whereby actual operation of the apparatus can be monitored at the central computer and whereby the apparatus can be controlled by the central computer in the event of 20 paging system failure.

Accordingly, it is a general object of the present invention to provide a new and improved medication dispensing system.

It is a further object of the present invention to 25 provide a wireless medication dispensing and timing system in which a patient is prompted to take medication in accordance with a prescribed medication dispensing schedule.

It is another object of the present invention to provide 30 a medication dispensing and timing system responsive to control signals generated by a central monitoring facility in which the patient is prompted in accordance with a prescribed medication schedule, and in which an acknowledgment that the patient received the prompt is transmitted back to the monitoring facility, and in which an alarm is sounded when the 35 patient has not acknowledged the prompt within a predetermined period of time following the prompt.

It is a further object of the present invention to

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provide a medication dispensing and timing system that utilizes a dispenser to provide a dose of medicine according to a medication schedule. The dispenser communicates through the use of a paging system as well as a backup phone line communication network. An alarm signal is generated by the monitoring computer when the dispensed dose of medication is not removed from the dispenser within a predetermined time period. Also, the dispenser keeps a detailed record of what types of medication were dispensed at what time, and when they were removed.

It is a more specific object of the present invention to provide an improved medication dispensing and timing system whereby a two-way paging system is utilized to transmit prompting messages from a central monitoring facility to individual paging receivers to provide a prompt. The medication schedule may be conveyed to the monitoring facility by a pharmacist or other entity licensed to dispense medication by means of a computer terminal at the pharmacy and a telephone line connection between the terminal and the monitoring computer. When a push-button switch is activated by the patient, the communicator generates a confirmation signal which is sent to the monitoring computer to confirm that the prompt has been received by the patient. An alarm signal is generated by the monitoring computer when an acknowledgment is not received from the pager within a predetermined time period following receipt of a dispensing command signal.

It is a further object of the present invention to provide a wireless medication dispensing system responsive to periodic time reference signals in which a patient is alerted according to a prescribed medication dispensing schedule.

It is another object of the present invention to provide a medication dispensing system responsive to time reference signals generated by a central monitoring facility in which the patient is alerted in accordance with a predetermined medication schedule, and in which a confirmation that the patient has acknowledged the prompt is transmitted back to the

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monitoring office, and in which an alarm is sounded when the patient has not acknowledged the prompt within a predetermined period of time following the prompt.

It is a more specific object of the present invention to provide an improved medication dispensing system whereby commercially available two-way paging systems paged from a central monitoring office transmit coded time reference signals to individual paging receivers which have stored the medication schedule of their associated patient to provide a medication prompt to a patient so the patient takes medication in accordance with a pre-established dosage and timing schedule. The schedule may be conveyed to the monitoring office by a pharmacist or other entity licensed to dispense medication by means of a computer terminal and telephone line connection or the like. When the pager is activated by the patient, the dispenser generates a confirmation signal which is sent to the monitoring center to confirm that the prompt has been received by the patient. An alarm signal is generated by the monitoring center when an acknowledgment is not received from the pager within a predetermined time frame following receipt of a dispensing command signal.

It is another object of the present invention to provide a medication dispensing system having a patient communicator responsive to time signals generated by an internal clock in which the patient is alerted in accordance with a predetermined medication schedule, and in which a confirmation that the patient has acknowledged the prompt is transmitted back to the monitoring office, and in which an alarm is sounded when the patient has not acknowledged the prompt within a predetermined period of time following the prompt.

It is a more specific object of the present invention to provide an improved medication dispensing system wherein a two-way paging system includes a patient communicator device having an internal timer and stored medication schedule to provide a prompt to a patient so the patient takes medication in accordance with a pre-established dosage and timing schedule. The schedule may be conveyed to the monitoring

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office by a pharmacist or other entity licensed to dispense medication by means of a computer terminal and telephone line connection or the like. When the pager is activated by the patient, the dispenser generates a confirmation signal which 5 is sent to the monitoring center to confirm that the prompt has been received by the patient. An alarm signal is generated by the monitoring center when an acknowledgment is not received from the pager within a predetermined time frame following receipt of a dispensing command signal.

10 Summary of the Invention

The invention is directed to a medication dispensing and timing system comprising central monitoring means for generating a prompt signal for each dosage of medication called for by a predetermined medication schedule associated 15 with a particular patient, a communicator including a uniquely addressed receiver associated with the particular patient having means for prompting the patient to take each predetermined dose of medication and a wireless communication network for conveying the prompt signal to the uniquely-addressed receiver. The communicator may further include 20 transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of the prompt signal. An additional wireless communication network conveys the reply signal to the central monitoring means, and the 25 central monitoring means includes alarm generating means responsive to the reply signal for initiating a predetermined follow-up procedure in the absence of the reply signal following the lapse of a predetermined time period following the prompt signal.

30 The invention is further directed to a medication dispensing system operable over a two-way paging system, the dispensing system comprising central monitoring means for generating a prompt signal for each dose of medication called for by a predetermined medication schedule associated with a 35 particular patient, a patient communicator including a uniquely addressed receiver associated with the patient having

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means for prompting the patient to take each predetermined dose of medication, the patient communicator further including transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of the prompt signal, and the central monitoring means including alarm generating means responsive to the reply signal for initiating a predetermined follow-up procedure in the absence of the reply signal following the lapse of a predetermined time period following the prompt signal.

10 In an alternative embodiment, the invention is directed to a medication dispensing system comprising central monitoring means for generating periodic time reference signals, at least a portion of the reference signals corresponding to the designated times of individual dosages of a predetermined patient medication schedule, a receiver associated with the patient for receiving the periodic time reference signals, a wireless communication network for conveying the time reference signals to the receiver, and the receiver including memory means responsive to the reference signals and containing said medication schedule for providing a prompt to the patient at the designated times of the dosages.

25 The invention is further directed to a medication dispensing system comprising central monitoring means for generating periodic time reference signals, at least a portion of the reference signals corresponding to the designated times of individual dosages of a predetermined patient medication schedule, a receiver associated with the patient for receiving the periodic time reference signal, a wireless communication network for conveying the time reference signals to the receiver, the receiver including memory means responsive to the reference signal for providing a prompt to the patient at the designated times of the dosages, the receiver further including transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of the prompt signal, an additional wireless communication network for conveying the reply signal to the central

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monitoring means, and the central monitoring means including alarm generating means responsive to the reply signal for initiating a predetermined follow-up procedure in the absence of the reply signal following the lapse of a predetermined time period following each of the dosage times.

In yet another embodiment, the invention is directed to a medication dispensing system comprising central monitoring means including memory means containing a predetermined medication dispensing schedule associated with a particular patient, a communicator associated with the patient having memory means containing the medication dispensing schedule, day and time indicative clock means, and means responsive to the memory means and the clock means for prompting the patient to take medication in accordance with the schedule, the receiver including transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of the prompt signal, an additional wireless communication network for conveying the reply signal to the central monitoring means, and the central monitoring means including alarm generating means responsive to the reply signal for initiating a predetermined follow-up procedure in the absence of the reply signal following the lapse of a predetermined time period following the prompt signal.

The invention is further directed to a medication dispensing system comprising central monitoring means including memory means containing a predetermined medication dispensing schedule associated with a particular patient, a communicator associated with the patient having memory means containing the medication dispensing schedule, day and time indicative clock means, and means responsive to the memory means and the clock means for prompting the patient to take medication in accordance with the schedule, the communicator including transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of the prompt signal, an additional wireless communication network for conveying the reply signal to the central monitoring means, the central monitoring means including alarm

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generating means responsive to the reply signal for initiating a predetermined follow-up procedure in the absence of the reply signal following the lapse of a predetermined time period following the prompt signal, the communicator including  
5 uniquely-addressed receiver means for receiving a message from the monitoring means and providing a prompt to the patient in response thereto, the follow-up procedure including a prompt message addressed to the receiver, and a wireless network for conveying prompt messages from the central monitoring means to  
10 the uniquely addressed receiver.

Brief Description of the Drawings

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The invention, together with the further objects and  
15 advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings, in the several figures of which like reference numerals identify like elements, and in which:

Figure 1 is a simplified functional block diagram of a  
20 medication dispensing and timing system constructed in accordance with the invention.

Figure 2 is an enlarged perspective view of a patient communicator utilized in the medication dispensing and timing system of Figure 1.

25 Figure 3 is a simplified flow chart illustrating the operation of the central monitoring computer of the medication dispensing and timing system of Figure 1.

Figure 4 is a simplified flow chart illustrating the  
30 operation of the patient communicator utilized in the medication dispensing and timing system of Figure 1.

Description of the Preferred Embodiments

Referring to the Figures, and particularly to Figures 1 and 2, a medication dispensing and timing system 10 constructed in accordance with a preferred embodiment of the  
35 invention for prompting multiple patients having different

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medication schedules to take medication includes a two-way personal patient communicator 11 associated with each patient, a two-way wireless communication system 12, a single central monitoring facility 13 and a plurality of pharmacist stations 5 14.

Referring to Figure 2, the patient communicator 11 is seen to include a display screen 15 on which an alpha-numeric message is displayed. Typically, this message may indicate the time and date of a prescribed medication event, the 10 reference number of that event, and optional detail as to which medications are included in the event. A hinged cover 16 may be provided to cover screen 15 when the communicator 11 is not in use.

To allow for patient input the communicator may include a 15 pair of left-right cursor keys 17 and 18 and a pair of up-down cursor keys 20 and 21. An enter key 22 functions as a confirmation key in accordance with indicia on display screen 15 to enable the patient to confirm receipt of a medication prompt on the screen. An alarm 23 may be incorporated in 20 communicator 11 to audibly alert the patient of the need to take medication, and a data port 24 may be optionally provided to enable data to be exchanged between the communicator and another device, such as a medication dispensing apparatus 25 (shown in Figure 1).

In a manner well known to the art, paging messages may be supplied to communicator 11 by a plurality of paging sites 30, 25 each incorporating transmitting and receiving means whereby radio signals are transmitted to and received from communicator 11. These messages are typically conveyed to and from paging sites 30 by means of telephone lines or microwave links to a paging system control center 12. Within this center an outgoing message control circuit 31 controls the coding, timing and routing of outgoing messages, and an incoming message control circuit 32 controls the coding, 30 timing and routing of incoming messages. Conventional techniques may be utilized within the paging network control system 12, including a client communication circuit 33 and

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modem 34, to establish communication over a telephone line or other communication link with the monitoring facility 13.

Within monitoring facility 13 messages to and from the paging network are processed by a modem 35, which communicates with a monitoring computer 36. Computer 36 also communicates with each pharmacist station 14 through a modem 37 within monitoring facility 13. Modem 37 is connected by a telephone line or equivalent communication link to a modem 38 within the pharmacist station and a conventional terminal 40 having a printer 39 optionally attached thereto. This terminal enables the pharmacist to retrieve and input information regarding a particular patient medication dispensing schedule, including the time of each patient reply.

Monitoring computer 36 also receives time and date information from a clock circuit 41. A terminal 42 is connected to monitoring computer 36 to enable an operator at the monitoring facility to selectively page a particular patient, to call up the medication dispensing history of a particular patient, or to review and/or modify the medication schedule of a particular patient. A printer 43 allows for the generation of written reports and documentation as required in the operation of the monitoring center.

Monitoring computer 36 may be conventional in structure and operation. In particular, the computer may include a conventional microprocessor 44, a plurality of input-output circuits 45-49, a memory 50 for storing patient medication dispensing schedules and other information, and a ROM 51 for storing the operating program and other required system information.

In operation, messages may be addressed to individual patient communicators 11. These messages are generated within monitoring computer 36 as required by the particular patient's medication schedule. In particular, at the time medication is called for by the medication schedule, monitoring computer 36 generates a message addressed to the communicator 11 of that particular patient conveying the date and time, the consecutive number of the particular medication event, and

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optionally detail as to the composition of the event. In the illustrated example the event occurred on January 5, 1995 at 6:00 p.m. and was event number thirty-eight on this schedule. Two pills of a first medication identified as "ZAN" and 1 pill of a medication identified as "GYC" are called for. An acknowledgment by the patient is requested.

The message generated by monitoring computer 36 is addressed specifically to a single communicator 11, and is conveyed through modems 35 and 34, and communications manager circuit 33 to the outgoing message management circuit 31. From there the message is conveyed to paging sites 30 for transmission to the specific communicator 11. In the case of a two-way system as shown, the system 12 may be knowledgeable as to the whereabouts of the addressed communicator and therefore may need only provide an outgoing message at the paging site 30 closest to the communicator.

Alternatively, time reference messages may be addressed to all patient communicators 11. These time reference messages are periodically generated within monitoring computer 36 in response to time-indicative signals from clock 41.

The time reference messages generated by monitoring computer 36 are conveyed through modems 35 and 34, and communications manager circuit 33 to the outgoing message management circuit 31. From there, the message is conveyed to paging sites 30 for transmission to all communicators 11. Again, in the case of a two-way system as shown, the system 12 may be knowledgeable as to the whereabouts of the communicators and therefore may need only provide outgoing message at the paging sites 30 closest to the communicators.

Within each communicator 11 sufficient memory is provided to store the medication schedule of a patient. Receiver circuitry within the communicator receives the time reference signal and utilizes this to search the memory and, if medication is required, develops a prompt message for the patient.

Each communicator 11 includes signal processing circuits 58 for processing signals sent to the communicator by

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monitoring computer 36. Each communicator 11 further includes transmit circuits 59 for transmitting signals from the communicator to central monitoring computer 36. In addition, each communicator 11 includes input/output interface units 60-5 65 for interfacing each peripheral circuit with microprocessor unit 66. Each communicator also includes a date and time 10 clock circuit 68 and sufficient memory, comprising electrically programmable read only memory unit 67 and read only memory unit 68, for storing the medication schedule of a particular patient and/or instructions for system operations. 15 Circuitry within the communicator receives the time reference signal from clock 68 and utilizes this to search the memory and, if medication is required, develops a prompt message for the patient.

15 Communicator 11 displays an alpha-numeric message as shown. The audible alarm 23 is sounded to alert the patient to review the message. Upon reviewing the message, the patient depresses switch 22, causing the communicator to send 20 a message to monitoring computer 36 by way of the paging system site 30, the incoming message control circuit 32, client message control circuit 33 and modems 34 and 35.

25 Monitoring computer 36 initiates an alert routine in the event that a reply message is not received from communicator 11 within a predetermined period of time  $T_1$ , following a time of the last medication event. For example, if  $T_1$  is 10 minutes, and if medication is prescribed to be taken at 6:00 p.m. and no response has been received from communicator 11 by 6:10 p.m., monitoring computer 36 initiates another medication 30 prompting message to communicator 11 for the purpose of reminding the patient that he still has not taken his prescribed medication. If a reply is not received in a further predetermined time period  $T_2$ , say two minutes, the operator at monitoring facility 13 is alerted through terminal 42 and printer 43 of a non-responsive condition. At this 35 time, a telephone call may be made to 1) the patient, 2) the patient's care providing facility, 3 the patient's physician, 4) the drug filling the prescription, or 5) another person

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designated to physically check up on the patient. These telephone calls are duly logged and, if necessary, emergency agencies can be contacted for further assistance.

The medication dispensing apparatus 25 may be optionally included in medication dispensing system 10. In this instance, to dispense medication from apparatus 25 it is necessary that the data port 24 of communicator 11 be connected with a data port 52 on apparatus 25. This connection having been made, a unit ID circuit 53 and cassette ID circuit 54 within dispenser 25 may require a match with unit and cassette ID numbers included in the medication prompting message. Only in the event of such a match, will dispenser 25 dispense medication to the patient. This precludes the patient from inadvertently taking dangerous multiple doses of medication by repeatedly actuating the dispensing apparatus.

Also, communicator 11 may be programmed to transmit a confirmation signal only upon medication dispenser 25 providing a signal at data port 24 which indicates that the medication has in fact been dispensed and removed from a hopper 55 of the dispenser.

The medication dispensing apparatus 25 may include a modem 56 for connection to a telephone line 57, which connects the dispenser to modem 37 at the central monitoring facility. This communication link may be used for confirming actual operation of the apparatus to monitoring computer 36, or by computer 36 to control the dispensing apparatus in the event of failure of the paging system.

Patient communicator 11 may include a computer for processing and controlling the device. Conventional receiver circuits receive incoming messages, which are applied to signal processing circuits 58 to derive the time reference signals sent to all communicators and the messages individually-addressed to the particular communicator. The computer, which may be conventional in construction and operation, includes a microprocessor 66 and related input-output circuits 60-65, an EPROM 67 and a ROM 68. The

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medication schedule of the particular patient serviced by the communicator is contained in EPROM 67, and operating software and various constants are contained in ROM 68. Data port 24 provides for entering the medication schedule in EPROM 67. A date-time clock circuit 68 provides a signal to the computer indicative of current date and time.

The operation of the medication dispensing system 10 is illustrated in Figures 3 and 4. There it is seen that the time and date output of clock circuit 41 is utilized in a table look-up operation 70 to determine whether a medication dispensing event is called for in any of the medication schedules stored within the system memory 50. This may be accomplished directly. Alternatively, the time and date information may be utilized at 67 to generate time reference messages for transmission to all system communicators 11. Medication schedules stored within memory 50 may be monitored, modified or deleted at any time by inputs from either the local terminal 42 or any of the pharmacist terminals 40. In practice, appropriate safeguards may be provided to prevent a pharmacist from modifying or deleting selected patient medication schedules, including patient medication schedules with which he is not involved.

In the event the schedule look-up procedure 70 identifies one or more medication events to be accomplished at the then existing time and date a dispense list is formed at 71 containing the medication events to be accomplished. If it is established that one or more such events exist at 72 a prompt message addressed to each particular patient's communicator 11 is prepared and sent at 73. At the same time, at 74 a list of pending events is formed for storage in a pending list memory 75. The process then continues with the next event.

In the event that a reply is received from a patient communicator 11, the reply is recognized at 76 and caused at 77 to delete that particular pending event from the pending list 75. At the same time, each medication event on pending list 75 is retrieved at 78 for possible further action. In the event that a period of time in excess of the predetermined

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time interval  $T_1$  has elapsed since the pending event as determined at 80, a follow-up prompt is generated and sent at 81. In the event that the time period has not been exceeded, the next subsequent pending event is retrieved at 78 for evaluation.

5 In the event that the follow-up prompt generated at 81 is not followed by a reply within a second predetermined time interval  $T_2$  as determined at 82, a routine is begun at 83 which may include further follow-up prompt messages, a call to the patient, a call to the patient's care provider, a call to the patient's doctor, a call to the patient's pharmacist or a call to some designated individual. All such events are recorded at 84 within the monitoring computer of the system.

10 Referring now to Figure 4, within communicator 11 receiver circuits 85 derive digital messages which are analyzed at 86 and 87 to determine whether the incoming message is for the particular communicator. In the event that it is, the message is displayed on display screen 15 and the audible alarm 23 is sounded. After a period of time determined at 87 alarm 23 is reset pending receipt of another message. Messages are also analyzed at 88 to determine whether they represent changes, which are stored at 90 within memory 64. If the message is determined at 91 to be a time reference message, at 92, a look-up procedure at 93 determines 20 whether medication is to be taken. If so, at 94 the event is caused to be displayed by 95 on display 15 and alarm 23 is activated. A time-out at 96 resets the alarm. The output of clock 68 is utilized in a look-up table 93 within memory 64 to determine when medication is to be taken. If so, at 94 the 25 event is caused to be displayed by 95 on display 15 and alarm 23 is activated. Again, a time-out at 96 resets the alarm.

30 Acknowledgment of the prompting message is initiated by the patient actuating switch 22, which causes a reply message including the communicator address to be generated at 97 for transmission by transmitter circuitry 59 within the communicator to the medication dispensing and timing monitoring center 13. There, the reply message is utilized in

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the manner previously described to account for completion of the medication event.

5 In the event that the system is provided with medication dispenser 25, incoming messages are provided through data port 24 and completion of the dispensing operation is indicated through data port 24 for initiation of a reply message at 97.

10 Alternatively, in the event a one-way paging system is utilized, confirmation of receipt of the prompt signal, and optionally actual dispensing of the prescribed medication, may be accomplished by sending a suitable confirmation signal from 15 dispenser 25 to monitoring computer 36 over telephone line 57.

15 It will be appreciated that various safeguards can be incorporated into the system. For example, a discrete code may be included in each prompt message for comparison to an identical discrete code stored within the communicator. Only 20 in the event of a match of these codes will the message be recognized. Similarly, a discrete code may be required in each reply message to verify the authenticity of the reply signal. As previously developed, in the case of dispensing apparatus 25 it may be necessary that an electronic serial 25 number 54 of the apparatus and the removable medication cassette 55 utilized therein match before the apparatus will respond to a medication prompt message or provide a reply indicative that dispensing has occurred. Furthermore, 30 communications between the paging system 12 and the monitoring facility 13, and between the pharmacist station 14 and the monitoring facility 13 may be encrypted or otherwise protected by similar coding to confirm authenticity.

35 Alternatively, in the event a one-way paging system is utilized, confirmation of receipt of the prompt signal, and optionally actual dispensing of the prescribed medication, may be accomplished by sending a suitable confirmation signal from dispenser 25 to monitoring computer 36 over telephone line 57.

35 While a particular embodiment of the invention has been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made therein without departing from the invention in its broader aspects,

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and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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**WE CLAIM:**

1. A medication dispensing system comprising:  
central monitoring means for generating a prompt signal  
for each dosage of medication called for by a predetermined  
medication schedule associated with a particular patient;
- 5 a communicator including a uniquely addressed receiver  
associated with said patient having means for prompting said  
patient to take each predetermined dose of medication;
- 10 a wireless communication network for conveying said  
prompt signal to said uniquely-addressed receiver;
- 15 said communicator further including transmitter means  
responsive to an external control effect for generating a  
reply signal acknowledging receipt of said prompt signal;  
an additional wireless communication network for  
conveying said reply signal to said central monitoring means;  
and
- 20 said central monitoring means including alarm generating  
means responsive to said reply signal for initiating a  
predetermined follow-up procedure in the absence of said reply  
signal following the lapse of a predetermined time period  
following said prompt signal.

2. A medication dispensing system as defined in claim 1  
wherein said wireless communication network is a paging  
system, and said communicator is a two-way paging receiver.
3. A medication dispensing system as defined in claim 1  
wherein said external control effect comprises a patient-  
actuable switch.
4. A medication dispensing system as defined in claim 1  
wherein said patient prompting means comprise an alpha-numeric  
display viewable by the patient.
5. A medication dispensing system as defined in claim 1  
wherein said patient prompting means comprise a patient-  
audible alarm.

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6. A medication dispensing system as defined in claim 1 wherein said system includes a medication dispenser operable from said communicator whereby a predetermined dose of medication is dispensed according to a predetermined  
5 medication schedule.

7. A medication dispensing system as defined in claim 6 wherein said dispenser includes communication means for communicating with said receiver and producing a confirmation signal indicative of the dispensing of a dose of medication, and also if said dose of medication was taken from a hopper of  
5 said medication dispenser and said control effect is generated by said dispensing apparatus following receipt of said confirmation signal by said medication dispenser.

8. A medication dispensing system as defined in claim 6 wherein said dispenser includes memory means for receiving dispensing instructions from said receiver.

9. A medication dispensing system as defined in claim 6 wherein said dispenser includes memory means for keeping a detailed record of when the medication is taken.

10. A medication dispensing system as defined in claim 6 wherein a signal sent to said dispenser by said communicator includes a unique address associated with said dispenser, and said dispenser is responsive only to signals conveying said  
5 unique address.

11. A medication dispensing system as defined in claim 1 wherein said central monitoring means includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring means for  
5 conveying a patient medication schedule to the monitoring means.

12. A medication dispensing system as defined in claim 6

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wherein said central monitoring means includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring means for conveying a patient medication schedule to the monitoring means.

13. A medication dispensing system as defined in claim 12 wherein said pharmacist terminal further conveys a unique address associated with said dispenser to said central monitoring means.

14. A medication dispensing system operable over a two-way paging system, said dispensing system comprising:

central monitoring means for generating a prompt signal for each dose of medication called for by a predetermined medication schedule associated with a particular patient;

a patient communicator including a uniquely addressed receiver associated with said patient having means for prompting said patient to take each predetermined dose of medication;

10 said patient communicator further including transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of said prompt signal;

15 a modem for telephone line communication between a dispenser and said central monitoring means for confirmation of dispensing to said central monitoring means and control of said dispenser by said central monitoring means; and

20 said central monitoring means including alarm generating means responsive to said reply signal for initiating a predetermined follow-up procedure in the absence of said reply signal following the lapse of a predetermined time period following said prompt signal.

15. A medication dispensing system as defined in claim 14 further including a wireless communication system which comprises a paging system, and said patient communicator is a two-way paging receiver.

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16. A medication dispensing system as defined in claim 14 wherein said external control effect comprises a patient-actuable switch.

17. A medication dispensing system as defined in claim 14 wherein said patient prompting means comprise an alpha-numeric display viewable by the patient.

18. A medication dispensing system as defined in claim 14 wherein said patient prompting means comprise a patient-audible alarm.

19. A medication dispensing system as defined in claim 14 wherein said system includes a medication dispenser having communication means for communicating with said receiver and producing a confirmation signal indicative of the dispensing of a dose of medication, and said control effect is generated by said dispensing apparatus following receipt of said confirmation signal by said medication dispenser.

20. A medication dispensing system as defined in claim 19 wherein said dispenser includes memory means for receiving dispensing instructions from said receiver.

21. A medication dispensing system as defined in claim 20 wherein said dispensing instructions includes a unique address associated with said dispenser, and said dispenser is responsive only to signals conveying said unique address.

22. A medication dispensing system as defined in claim 14 wherein said central monitoring means includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring means for conveying a patient medication schedule to the central monitoring means.

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23. A medication dispensing system as defined in  
claim 19 wherein said central monitoring means includes a  
monitoring computer, and said system includes at least one  
pharmacist terminal located remote from said monitoring means  
5 for conveying a patient medication schedule to the central  
monitoring means.

24. A medication dispensing system as defined in  
claim 23 wherein said pharmacist terminal further conveys a  
unique address associated with said dispenser to said central  
monitoring means.

25. A dispensing system for dispensing medication in  
accordance with a predetermined medication schedule  
comprising:

5 central monitoring means for generating periodic time  
reference signals, at least a portion of said reference  
signals corresponding to the designated times of individual  
dosages of a predetermined patient medication schedule;  
memory means for storing said medication schedule;  
10 a receiver associated with said patient for receiving  
said periodic time reference signal;  
a wireless communication network for conveying said time  
reference signals to said receiver; and  
15 said memory means being responsive to said reference  
signals and providing a prompt to the patient at said  
designated times of said dosages.

26. A medication dispensing system as defined in  
claim 25 wherein said wireless communication network is a  
paging system.

27. A medication dispensing system as defined in  
claim 25 wherein said prompt comprises a visual display  
viewable by said patient.

28. A medication dispensing system as defined in

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claim 25 wherein said prompt comprises an audible alarm.

5

29. A medication dispensing system as defined in claim 25 wherein said central monitoring means includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring means for conveying a patient medication schedule to the monitoring means.

30. A medication dispensing system as defined in claim 29 wherein said dispenser includes communication means for communicating with said central monitoring means.

31. A medication dispensing system as defined in claim 30 wherein said dispenser includes means of producing a confirmation signal indicative of medication having been dispensed from said dispenser.

32. A medication dispensing system as defined in claim 29 wherein said dispenser includes memory means for keeping a detailed record of medication dispensed.

5

33. A medication dispensing system comprising:  
central monitoring means for generating periodic time reference signals, at least a portion of said reference signals corresponding to the designated times of individual dosages of a predetermined patient medication schedule;  
a receiver associated with said patient for receiving said periodic time reference signal;  
a wireless communication network for conveying said time reference signals to said receiver;  
10 said receiver including memory means responsive to said reference signals for providing a prompt signal to said patient at said designated times of said dosages;  
said receiver further including transmitter means responsive to an external control effect for generating a

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15 reply signal acknowledging receipt of said prompt signal;  
an additional wireless communication network for  
conveying said reply signal to said central monitoring means;  
and  
20 said central monitoring means including alarm generating  
means responsive to said reply signal for initiating a  
predetermined follow-up procedure in the absence of said reply  
signal following the lapse of a predetermined time period  
following each of said dosage times.

34. A medication dispensing system as defined in  
claim 33 wherein said wireless communication network is a  
paging system, and said receiver is a uniquely-addressed two-  
way paging receiver.

35. A medication dispensing system as defined in  
claim 33 wherein said external control effect comprises a  
patient-actuable switch.

36. A medication dispensing system as defined in  
claim 33 wherein said patient prompting means comprise an  
alpha-numeric display viewable by the patient.

37. A medication dispensing system as defined in claim  
33 wherein said patient prompting means comprise a patient-  
audible alarm.

38. A medication dispensing system as defined in claim  
33 wherein said system includes a medication dispenser having  
communication means for communicating with said receiver and  
producing a confirmation signal indicative of the dispensing  
5 of a dose of medication, and said control effect is generated  
by said dispensing apparatus following receipt of said  
confirmation signal by said medication dispenser.

39. A medication dispensing system as defined in claim  
38 wherein said dispenser includes memory means for receiving

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dispensing instructions from said receiver.

40. A medication dispensing system as defined in claim 38 wherein said information includes a unique address associated with said dispenser, and said dispenser is responsive only to signals conveying said unique address.

41. A medication dispensing system as defined in claim 33 wherein said central monitoring means includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring means for conveying a patient medication schedule to the monitoring means.

42. A medication dispensing system as defined in claim 38 wherein said central monitoring means includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring means for conveying a patient medication schedule to the monitoring means.

43. A medication dispensing system as defined in claim 42 wherein said pharmacist terminal further conveys a unique address associated with said dispenser to said central monitoring means.

44. A medical dispensing system as defined in claim 33 wherein said follow-up procedure includes sending a prompt message to said receiver, and said receiver includes a first address for receiving said time reference signal and a second address for receiving said prompt message.

45. A medication dispensing system comprising:  
monitoring means at a central location including memory means containing a predetermined medication dispensing schedule associated with a particular patient;  
5 a communicator at a location remote from said monitoring

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means and in proximity to said patient, said communicator having memory means containing said medication dispensing schedule, day and time indicative clock means, and means responsive to said memory means and said clock means for prompting said patient to take medication in accordance with the schedule;

10 said communicator including transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of said prompt signal;

15 a wireless communication network for conveying said reply signal to said central monitoring means; and

20 said monitoring means including alarm generating means responsive to said reply signal for initiating a predetermined follow-up procedure in the absence of said reply signal following the lapse of a predetermined time period following said prompt signal.

46. A medication dispensing system as defined in claim 45 wherein said external control effect comprises a patient-actuable switch.

47. A medication dispensing system as defined in claim 45 wherein said patient prompting means comprise an alpha-numeric display viewable by the patient.

48. A medication dispensing system as defined in claim 45 wherein said patient prompting means comprise a patient-audible alarm.

49. A medication dispensing system as defined in claim 45 wherein said system includes a medication dispenser having communication means for communicating with said receiver and producing a confirmation signal indicative of the dispensing of a dose of medication, and said control effect is generated by said dispensing apparatus following receipt of said confirmation signal by said medication dispenser.

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50. A medication dispensing system as defined in claim 49 wherein said dispenser includes memory means for receiving dispensing instructions from said receiver.

51. A medication dispensing system as defined in claim 49 wherein said information includes a unique address associated with said dispenser, and said dispenser is responsive only to signals conveying said unique address.

52. A medication dispensing system as defined in claim 49 wherein said dispenser includes communication means for communicating with said central monitoring means.

53. A medication dispensing system as defined in claim 49 wherein said dispenser includes means of producing a confirmation signal indicative of medication having been dispensed from said dispenser.

54. A medication dispensing system as defined in claim 49 wherein said dispenser includes memory means for keeping a detailed record of medication dispensed.

55. A medication dispensing system as defined in claim 45 wherein said central monitoring center includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring center for conveying a patient medication schedule to the monitoring office.

56. A medication dispensing system as defined in claim 49 wherein said central monitoring center includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring center for conveying a patient medication schedule to the monitoring office.

57. A medication dispensing system as defined in claim

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56 wherein said pharmacist terminal further conveys a unique address associated with said dispenser to said central monitoring office.

58. A medication dispensing system comprising:  
central monitoring means including memory means  
containing a predetermined medication dispensing schedule  
associated with a particular patient;

5 a communicator associated with said patient having memory means containing said medication dispensing schedule, day and time indicative clock means, and means responsive to said memory means and said clock means for prompting said patient to take medication in accordance with the schedule;

10 said communicator including transmitter means responsive to an external control effect for generating a reply signal acknowledging receipt of said prompt signal;

15 an additional wireless communication network for conveying said reply signal to said central monitoring means;

20 said central monitoring means including alarm generating means responsive to said reply signal for initiating a predetermined follow-up procedure in the absence of said reply signal following the lapse of a predetermined time period following said prompt signal;

25 said communicator including uniquely-addressed receiver means for receiving a message from said monitoring means and providing a prompt to said patient in response thereto;

26 said follow-up procedure including a prompt message addressed to said receiver; and

27 a wireless network for conveying prompt messages from said central monitoring means to said uniquely addressed receiver.

59. A medication dispensing system as defined in claim 58 wherein said wireless communication system is a paging system, and said uniquely addressed receiver is a two-way paging receiver.

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60. A medication dispensing system as defined in claim 58 wherein said external control effect comprises a patient-actuable switch.

61. A medication dispensing system as defined in claim 58 wherein said patient prompting means comprise an alpha-numeric display viewable by the patient.

62. A medication dispensing system as defined in claim 58 wherein said patient prompting means comprise a patient-audible alarm.

63. A medication dispensing system as defined in claim 58 wherein said system includes a medication dispenser having communication means for communicating with said receiver and producing a confirmation signal indicative of the dispensing of a dose of medication, and said control effect is generated by said dispensing apparatus following receipt of said confirmation signal by said medication dispenser.

64. A medication dispensing system as defined in claim 63 wherein said dispenser includes memory means for receiving dispensing instructions from said receiver.

65. A medication dispensing system as defined in claim 63 wherein said information includes a unique address associated with said dispenser, and said dispenser is responsive only to signals conveying said unique address.

66. A medication dispensing system as defined in claim 58 wherein said central monitoring center includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring center for conveying a patient medication schedule to the monitoring office.

67. A medication dispensing system as defined in claim

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63 wherein said central monitoring center includes a monitoring computer, and said system includes at least one pharmacist terminal located remote from said monitoring center  
5 for conveying a patient medication schedule to the monitoring office.

68. A medication dispensing system as defined in claim 67 wherein said pharmacist terminal further conveys a unique address associated with said dispenser to said central monitoring office.

FIG. I

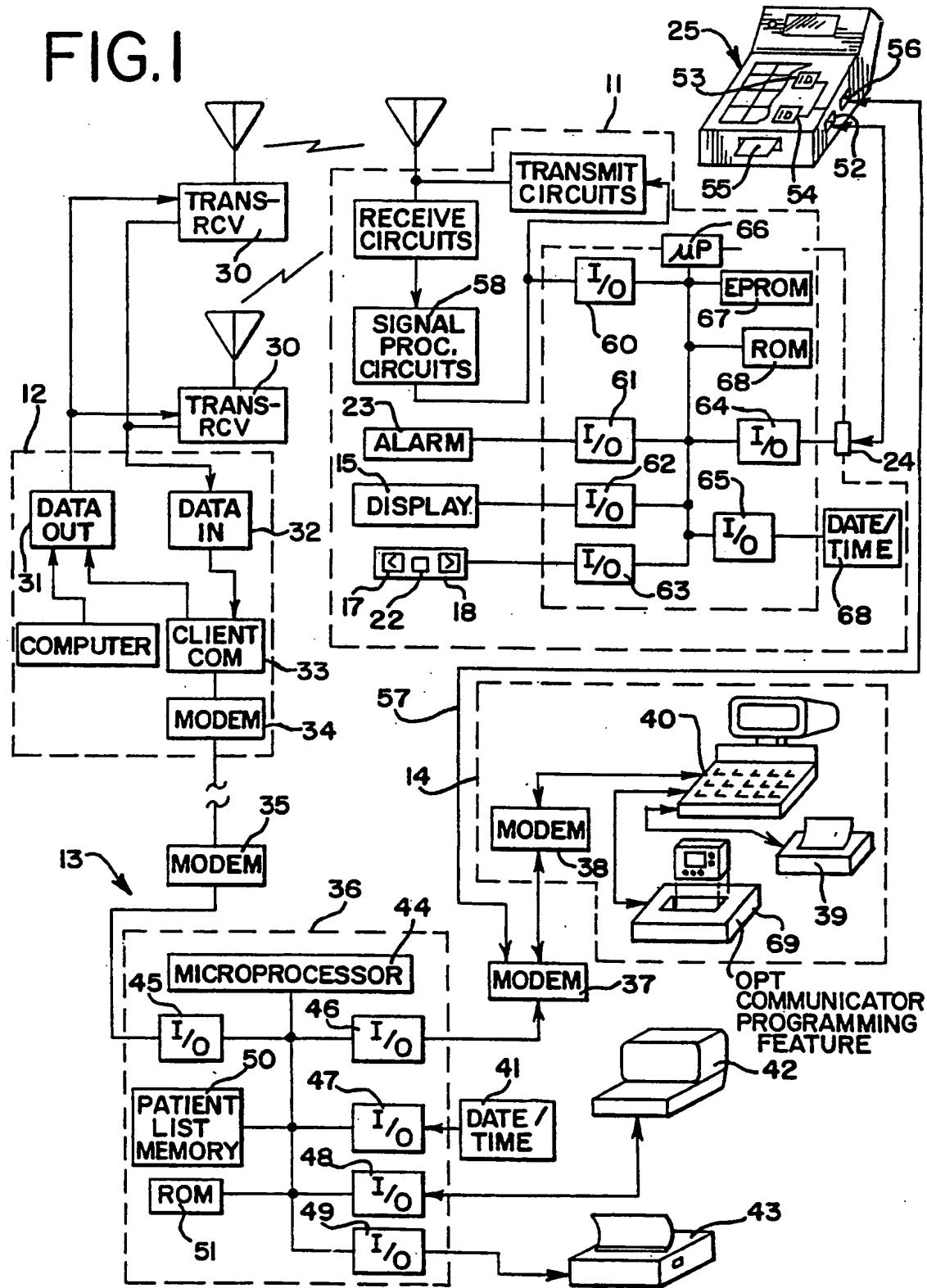


FIG.2

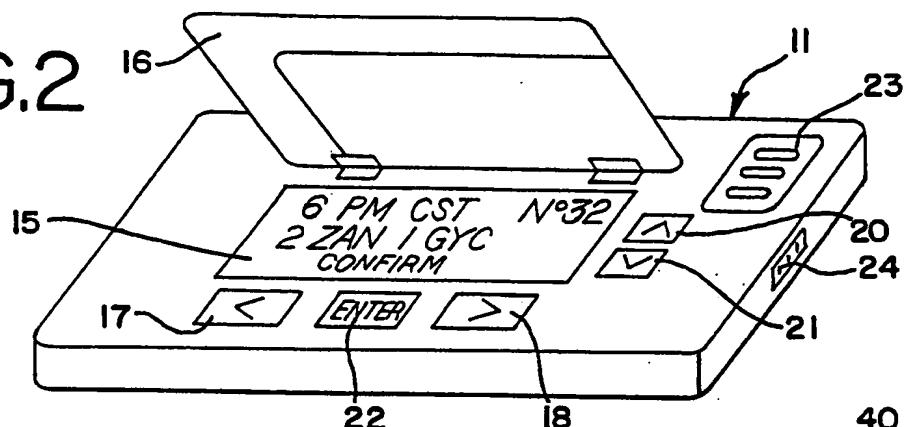


FIG.3

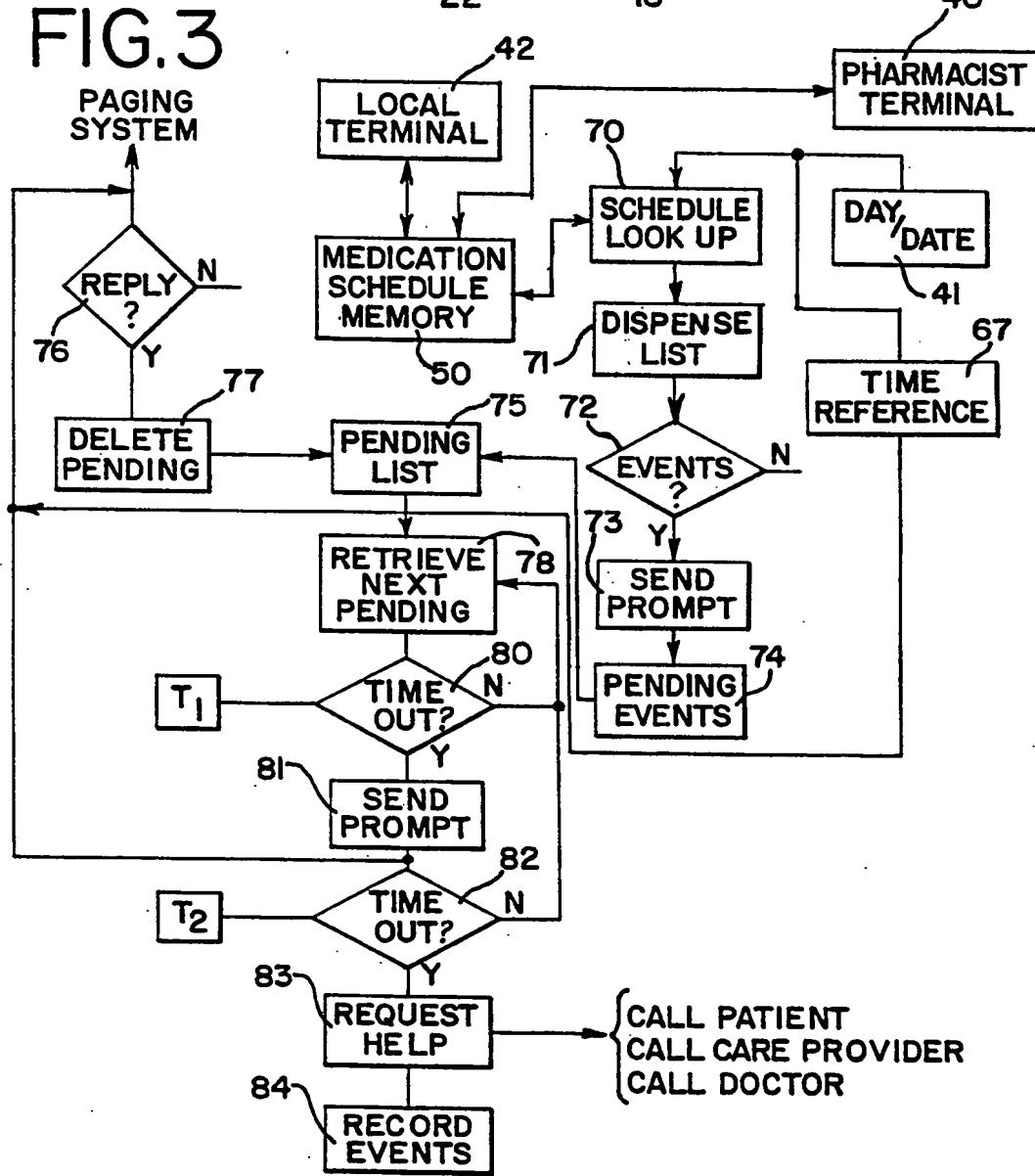
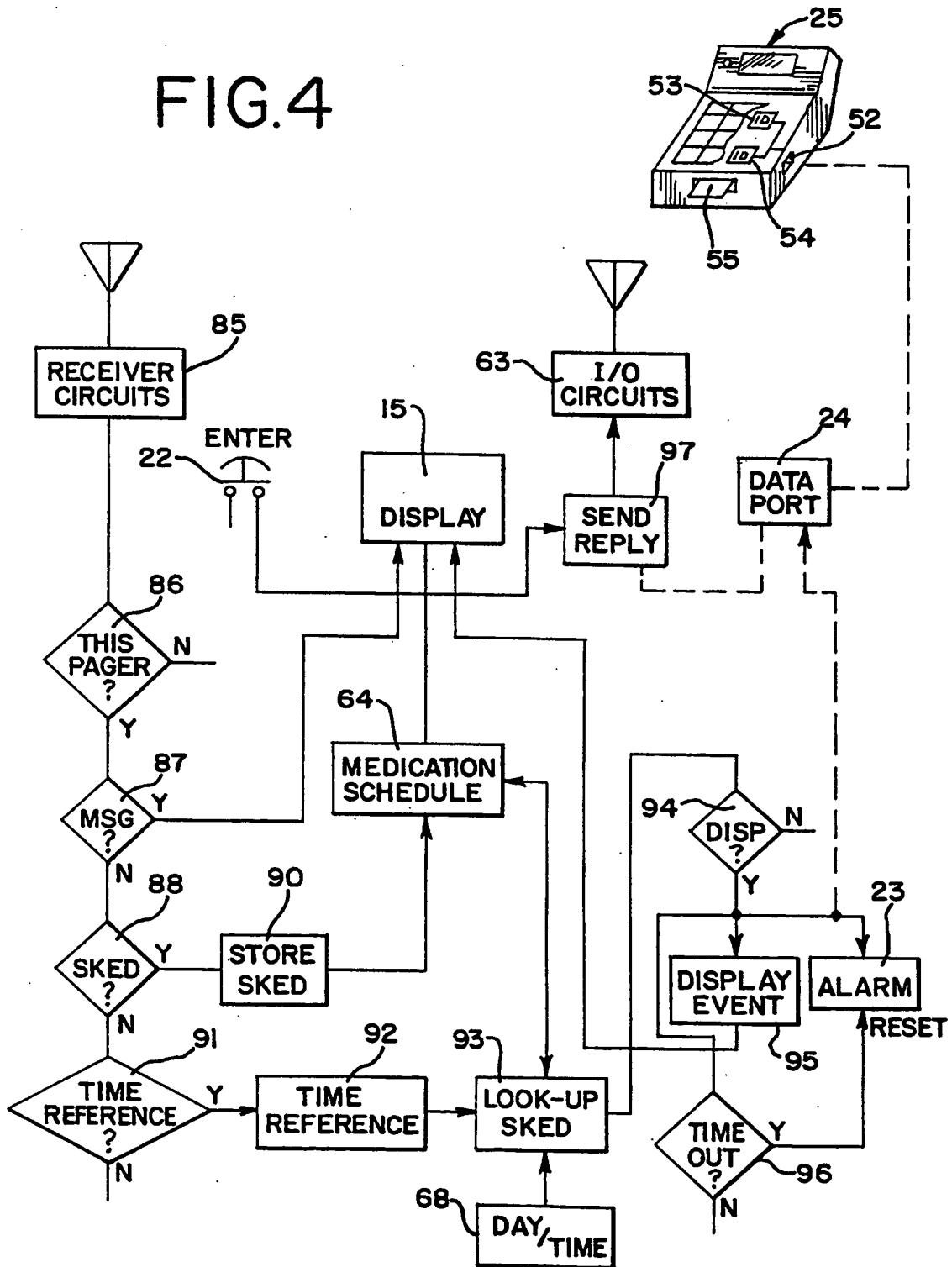


FIG.4



## INTERNATIONAL SEARCH REPORT

International application No.  
PCT/US97/14056

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) :G07C 1/00

US CL :Please See Extra Sheet.

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : Please See Extra Sheet.

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched  
noneElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
Please See Extra Sheet.

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,537,459 A (PRICE et al) 16 July 1996, Abstract, col. 4, lines 28-35, col. 10, lines 4-13, 32-37.	1-68
Y	US 4,504,153 A (SCHOLLMEYER et al) 12 March 1985, Abstract, col. 1 lines 19-24, 29-40, 43-47, col. 2, lines 28-40, col. 3, lines 43-46, col. 4 lines 35-38, 49-66, col. 9, lines 63-68, col. 10, lines 1-8	1-68
Y	US 5,582,323 A (KURTENBACH) 10 December 1996, Abstract, figure 10, col. 1, lines 50-53, col. 2 lines, 4-7, 23-27, 31-41, 47-54, col. 4, lines 38-52, col. 5, lines 6-32.	1-68

 Further documents are listed in the continuation of Box C.  See patent family annex.

* Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A" document defining the general state of the art which is not considered to be of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E" earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
18 OCTOBER 1997	19 DEC 1997

Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer HAL D. WACHSMAN Telephone No. (703) 305-9788
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**INTERNATIONAL SEARCH REPORT**

International application No.  
PCT/US97/14056

**A. CLASSIFICATION OF SUBJECT MATTER:**  
US CL :

364/479.01, 479.02, 479.11, 479.14; 221/1, 2, 3, 15; 340/825.44, 825.72, 286.07, 311.1

**B. FIELDS SEARCHED**

Minimum documentation searched

Classification System: U.S.

364/479.01, 479.02, 479.11, 479.14, 479.03, 479.07, 479.12, 478.01, 478.03, 478.04, 478.06, 478.09, 478.12, 478.13, 478.14, 478.15, 138, 140, 143, 148, 185, 550, 551.01, 569; 221/1, 2, 3, 5, 7, 8, 9, 11, 13, 15, 22, 30, 31; 340/825.44, 825.72, 286.07, 311.1

**B. FIELDS SEARCHED**

Electronic data bases consulted (Name of data base and where practicable terms used):

IEEE

Dialog

Maya

APS search terms: medication, dosage, patient, prompt, reply